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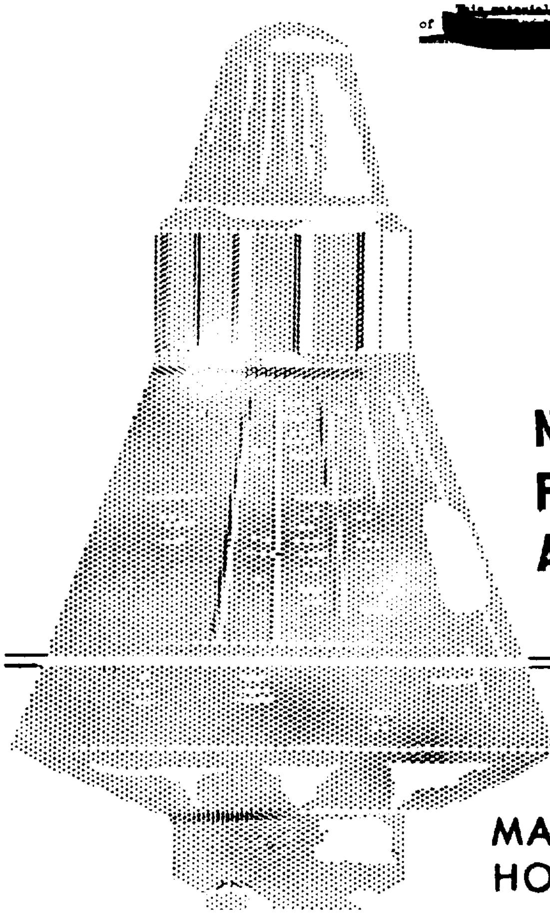

NO. 14
FOR PERIOD ENDING
APRIL 30, 1962

NASA

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PROJECT MERCURY

STATUS REPORT NO. 14

FOR

PERIOD ENDING APRIL 30, 1962

By Manned Spacecraft Center

INTRODUCTION

This is the fourteenth in a series of reports on the status of the NASA manned-satellite project, PROJECT MERCURY. Earlier status reports covered the progress made through January 31, 1962.

The hardware-construction and qualification phase of the 3-orbit spacecraft is essentially completed. Modifications of the 1-day-mission spacecraft are continuing with five spacecraft in this program. Four of the spacecraft under modification will perform orbital missions, and the remaining capsule will be used for integrated system tests on 1-day-mission systems.

Since the last reporting date, McDonnell Aircraft Corporation has delivered three more production spacecraft, making a total of 20. The breakdown of the delivered spacecraft is as follows: 12 have been flown; 1 is ready for launch; 2 are undergoing flight test prepartions; 4 have been returned to the contractor for modification to a 1-day mission capability; and 1 is being modified as a test-bed for 1-day-mission systems. Four MERCURY spacecraft, which have been flight tested, have been refurbished for static display by government agencies throughout the United States and many foreign countries. Two of these spacecraft (MR-3 and MA-6) will be on permanent display at the Smithsonian Institution.

One flight has been completed since January 31, 1962. MERCURY-Atlas 6 was successfully flown on February 20, 1962, for three orbits of the earth. Astronaut John H. Glenn, Jr., was pilot of the spacecraft on this three-orbit mission. At the beginning of the second orbit, the automatic control of yaw attitude became inoperative, a loss that required the pilot to revert to manual control of yaw for the remainder of the mission. This loss of control prevented the pilot from completing all flight-plan tasks, although all major tasks were completed.

MERCURY-Atlas 7 was originally planned for launch during this reporting period; however, because of the installation of additional instrumentation for a temperature survey and a request for a 1-week delay by the Navy Department to avoid conflict with a previously scheduled naval exercise, the launch has been rescheduled for May.[1] This flight will be the second 3-orbit mission.

Modifications to the MERCURY 3-orbit spacecraft are continuing and tests of the various systems are being formulated for the 1-day-mission spacecraft. The first 1-day-mission spacecraft is scheduled for delivery to Cape Canaveral during the month of July 1962.

MANUFACTURING AND DELIVERY

The manufacturing and delivery effort, including disposition after flight test, of PROJECT MERCURY spacecraft is discussed in this section. The spacecraft discussed will include only those readily available to the Manned Spacecraft Center (MSC).

Spacecraft 1 (Beach Abort) was withdrawn from storage at McDonnell Aircraft Corporation, St. Louis, Missouri, and prepared for display. Preparations were completed by March 30, 1962. The spacecraft was shipped on April 6, 1962, to the NASA Public Affairs Office (PAO), Manned Spacecraft Center, Houston, Texas.

Spacecraft 2 (MR-1) was modified so that special Reaction Control System (RCS) tests could be conducted for 3-orbit missions. The spacecraft is presently being refurbished for further RCS tests of solenoid valves and redesigned thrust-chamber assemblies. The results of these tests will be used to evaluate the RCS components of MA-8 and MA-9 missions and all manned 1-day-mission spacecraft. Tests are scheduled to begin the last week of May 1962.

Spacecraft 5 (MR-2) was in storage at Langley Station from February 1 to April 27, 1962, at which time it was removed from storage and shipped to Cape Canaveral for use in egress and recovery training.

Spacecraft 6 (MA-2) was prepared for use as a display model by McDonnell Aircraft Corporation and was delivered to PAO in Houston, Texas, on February 5, 1962.

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[1] Editor's note: The MA-7 mission was flown successfully on May 24, 1962, with Astronaut M. Scott Carpenter at the controls for a full three orbits of the earth.

Spacecraft 8A (MA-4) is in storage at McDonnell Aircraft Corporation pending future test assignments. The Project Gemini manager has requested the use of this spacecraft as a static test-bed for a controller integrated test equipment study. Approval was granted by the MERCURY project office during the fourth week of April 1962.

Spacecaft 9 (MA-5) is presently being modified to the manned 1-day-mission spacecraft configuration and will be used as a test article for integrated systems tests in Project Orbit and will be designated spacecraft 9A. Tests are scheduled to begin during the second week of August 1962.

Spacecraft 10 (Project Orbit) tests in February 1962 were centered around the improvement of the thermal transfer for the roll thrusters the RCS The RCS was modified to the same configuration as spacecraft 18. Tests are being performed to verify that the system is acceptable for the mission, and are scheduled to be completed by May 4, 1962. This spacecraft will also be used for preflight evaluation of the MA-8 and MA-9 missions.

Spacecraft 12A (MA-13 previously MA-10) was returned to McDonnell Aircraft Corporation on February 7, 1962, for conversion to the manned 1-day-mission configuration. It is now being modified and the present estimated date of delivery is in January 1963. After modification, the spacecraft will be designated as 12B.

Spacecraft 13 (MA-6) was launched on February 20, 1962, and recovered the same day after completing three orbits. After a post-flight evaluation at Cape Canaveral, the spacecraft was shipped to McDonnell Aircraft Corporation on March 15, 1962. The spacecraft was prepared for permanent display and was delivered on April 19, 1962, to the United States Information Agency for a worldwide tour, commencing on April 29, 1962. The spacecraft will finish its worldwide tour on August 1, 1962, at the World's Fair in Seattle, Washington.

Spacecraft 14A (LJ-5B) preparations for the parachute drop-test program (Project Reef) were completed, and the spacecraft was delivered to El Centro, California, on March 1, 1962. The spacecraft is available for drop-tests as required by test schedule. It is expected that this program will be completed by June 18, 1962.

Spacecraft 15A (MA-12 previously MA-13) is presently being converted to the manned 1-day-mission configuration. The present estimated delivery date is November 1962.

Spacecraft 16 (MA-8) is in a prelaunch preparation period at Cape Canaveral. The launch date has been delayed 13 weeks from the date published in figure 1 of Status Report No. 13. The delays in the launch of the MA-8 mission were due to a revision of the launch working schedule to lower overtime costs and to ease the pressure exerted on Cape personnel because of the short time between launches. Also, the urgency of the MA-8 mission is not as great as that of previous missions. This spacecraft is presently scheduled to be launched during the week of August 20, 1962.

Spacecraft 17 (MA-11 previously MA-12) is being converted to the manned 1-day-mission configuration. The present estimated date of delivery of spacecraft 17 is September 1962.

Spacecraft 18 (MA-7) was delayed 5 weeks from the date published in figure 1 of Status Report No. 13. This delay was caused by the installation of additional instrumentation, priority support of the MA-6 launch, and a request for a 1-week delay by the Navy Department to avoid conflict with a previously scheduled naval exercise. The present estimated date of launch is during the week of May 20, 1962.

Spacecraft 19 (MA-9) was delivered to Cape Canaveral on March 20, 1962. The delay in date of delivery from that quoted in Status Report No. 13 was at the request of MSC Preflight Operations Division. This delay enables more efficient use of manpower and facilities by precluding an overload of Cape facilities, which are equipped to handle only three spacecraft at the same time. This spacecraft is presently scheduled to be launched during the week of October 29, 1962.

Spacecraft 20 (MA-10 previously MA-11) is now being converted to the manned 1-day-mission configuration. The present estimated delivery date is July 23, 1962.

Figure 1, Project Mercury Master Planning Schedule, shows the date of spacecraft delivery, prelaunch preparation time, and the date of launch.

MAJOR SYSTEMS

Spacecraft

The present status and pertinent information for the various major systems of PROJECT MERCURY spacecraft are given in this section.

Configuration and weight.- There have been no significant configuration changes since Status Report No. 13. Additional equipment and detail changes have been made to the spacecraft to be used for the MA-7 mission. These changes, however, have resulted in no significant weight increase. The current orbit weight for the MA-7 spacecraft is

2,974 pounds, and the reentry weight is 2,688 pounds, assuming normal usage of hydrogen peroxide and water. These values are good approximations for all future MERCURY missions.

Structures.- During this reporting period, efforts in the structures area have been concentrated on the design, manufacture, and testing of a new spring-latched umbilical door; redesign of the astronaut leg support; refinement of the manufacturing technique on the ablation shields; and vibration and shock studies on the 1- and 6-pound thrust chambers. A detailed discussion of the work accomplished in these areas follows.

(a) Spring-latched umbilical door.- Redesign of this door was necessary due to the removal of the periscope from the spacecraft. The design for the door and fabrication of parts for the door are complete and the test setup to evaluate the adequacy and reliability of the design are also complete. The tests will be performed on the over-center mechanism after it has been properly rigged, with design ultimate loads being applied to the umbilical door and supporting structure. These tests should be completed by May 15, 1962.

(b) Modification of astronaut leg supports.- Redesign of the astronaut leg supports has been completed. The redesign deletes the requirement for knee straps, calf supports; and incorporates heel cups, a shield over the environmental area, and stowable paddles for lateral knee support. Basic concepts of the design and installation have been approved; although further redesign of the latches is required to increase their accessibility.

(c) Ablation shield manufacturing technique.- Efforts have been concentrated on refining the manufacturing technique to eliminate the void in bonding the center plug to the ablation shield. A sample plug installation was accomplished using the technique of preheating the bonding material in a vacuum. This technique resulted in a void of only about 5 percent in the bond. An ablation shield (serial No. 23) is presently undergoing a 3-week cure with the plug installation scheduled for early May 1962. The shield should be completed on approximately May 21, 1962. Results of bonding techniques on this shield will be covered in the next report.

(d) Vibration and shock testing of thruster chambers.- Modified 1- and 6-pound thrust chambers have been vibration and shock tested. During the vibration tests, the first unit failed. An investigation of the test setup revealed that the strap-to-heat sink simulation was not properly restrained. The unit was changed by adding production aluminium straps and simulating strap-to-heat sink connection. Also the 1- and 6-pound heat barriers were replaced and the run was repeated without failure. After modification of the test procedure to include low- and high-level sweeps in each axis, the unit was subjected to

1-minute dwells at each resonance in each axis. The tests were repeated with successive 2-minute periods of dwell until a total of 10 minutes was accumulated at each resonance in each axis. The unit was satisfactory and revealed no failure or leakage during the entire testing period.

The thrust-chamber assembly was subjected to the standard shock requirements and was satisfactory, revealing no structural failure.

(e) Preliminary interface specification.- The McDonnell Aircraft Corporation has prepared a preliminary interface specification, which has been assigned McDonnell Report No. 8779. This report is presently being reviewed by Space Systems Division (SSD), and General Dynamics/ Astronautics (GD/A). NASA and the McDonnell Aircraft Corporation will arrange a meeting for interested parties to finalize the report.

Rockets and pyrotechnics.- The status of rockets and pyrotechnics for both spacecraft configuration is as follows:

MERCURY 3-orbit missions.- A majority of the MERCURY escape rocket motors, which are presently in storage at the Cape, have exceeded the established original shelf-life period. McDonnell Aircraft Corporation has been requested to take immediate action in regard to the entire pyrotechnics storage-life situation. The problem is currently under review, and information in the form of recommendations is expected during the month of May 1962.

The electrically initiated cartridges for the antenna ejector have indicated in recent tests that numerous cartridges do not conform to established specifications with regard to resistance readings. This deficiency has been attributed to the cold flow of the nylon insulation material. The McDonnell Aircraft Corporation is now studying the possibility of substituting another material for the nylon.

Manned 1-day missions.- All items will be the same as for the MERCURY 3-orbit missions.

Parachute and landing systems.- As of April 27, 1962, 13 drop tests have been made in Project Reef. Five drops were made with the 3,000-pound test vehicle; reefing parameters of 10 percent for 6 seconds were used. These reefing parameters resulted in reefed loads averaging from 9,000 to 9,500 pounds and disreefed loads averaging 13,000 pounds. The reefing parameters were then changed to 10.65 percent for 6 seconds. Three drops were made and the successful drop showed that the loads tended to even out with the reefed load being 10,100 pounds and the disreefed load being 11,600 pounds. In the last drop of the series it was determined that unauthorized non-MERCURY stainless steel reefing cutters abraded the nylon reefing line, and caused premature disreefing and high disreefed loads.

This condition has been corrected by directing the contractor to use the MERCURY reefing cutter. In addition, the reefing cutter was reoriented on the stronger reefing line and areas of the parachute deployment bag were strengthened.

The test series, in which the 3,000-pound test vehicles were to be used, was interrupted and a series of four high q drops were scheduled using a 2,750-pound test vehicle with 12 percent, 4 second reefing. These tests were conducted to check the parachute loads of the present 3-orbit spacecraft for a failed-drogue condition. The load readings of the five drops, to date, indicate that the reefing parameter of 12 percent for 4 seconds is satisfactory for the present 3-orbit spacecraft. The reefed and disreefed loads deployment at a q of 94 to 97 psf were well within the design load of the parachutes. Three additional drops, in which the 2,750-pound test vehicle will be used, are scheduled before the tests using the 3,000-pound test vehicles will be resumed.

Environmental Control System.- The current status of the Environmental Control System (ECS) is as follows:

(a) The 750 cc/min constant bleed orifice has been deleted from the ECS. High oxygen usage rates and difficulties encountered in ground testing are the reasons for this change.

(b) The oxygen partial pressure sensor has been moved from the suit circuit to the cabin, since any nitrogen leak from the RCS would first appear in the cabin.

(c) To improve system reliability, the emergency oxygen rate system has been redesigned to use a solid bar for connecting the emergency rate valve and the suit circuit shutoff valve. In the earlier configuration, a flexible cable was used which required repeated adjustments to maintain proper operation.

(d) The oxygen-flow sensors were unreliable and have been deleted from spacecraft 18. The 1-day-mission spacecraft will have a pressure switch which actuates a warning tone to alert the astronaut that flow has begun from the secondary oxygen-supply system.

(e) Considerable difficulty has been encountered with the thermal switches on the pressure suit and the cabin-heat-exchanger exhaust ducts which warn the astronaut of the exchanger freezeup. Temperature sensors have been added within these exhaust ducts to provide the pilot with a more positive indication of the freezing hazard.

(f) A CO_2 partial pressure sensor is being developed and evaluated in-house. The sensor will be added to the pressure-suit system during future MERCURY missions of longer duration to measure CO_2 content. Pilot and telemetry indication will be provided. Pilot audio and light alarm will be activated at 8 mm Hg CO_2 partial pressure. This measurement has not been made in previous flights since a reliable sensor has not been available and the danger of saturation of the LiOH cannister has been remote on short-time missions.

(g) The weight of lithium hydroxide has been increased from 4.6 pounds to 5.6 pounds for the manned 1-day-mission spacecraft.

Pressure suit.- The following modifications have been or are being applied to the pressure-suit assembly:

(a) Installation of pockets on the upper-arm sections for a handkerchief.

(b) Installation of pockets on the front lower legs for accessory equipment of the astronaut's choice.

(c) Replacement of the friction-type buckles on the boot restraint straps with snap fasteners.

(d) Installation of fingertip lights on the index and middle fingers of both gloves with a self-contained powerpack and switch. The powerpack and switch are mounted on the back of the gloves.

(e) Installation of a lifevest on the chest area of the suit beneath the parabolic mirror.

The following developmental items have been initiated to improve the present pressure-suit configuration:

(a) Purchase of visor-seal inflation bottles designed to eliminate the present swivel hose fitting configuration, which has been a source of leakage.

(b) Testing of a newly developed chemical defogging compound to be applied to the helmet visor.

(c) Incorporation of a block-and-tackle-type helmet tiedown mechanism which will allow helmet adjustment when the suit is pressurized.

(d) Development of an automatic water-check inlet port ventilation fitting.

Development of an advanced state-of-the-art pressure-suit torso for the manned 1-day-mission has been initiated. Primary areas for improvement will include unpressurized comfort, ventilation, and pressurized mobility.

Design criteria have been developed and procurement has been initiated for an advanced state-of-the-art pressure-suit helmet. A contract has been awarded to the B. F. Goodrich Company for this helmet, which will incorporate an electrically heated visor with additional light attenuation features and a mechanical visor seal mechanism. This mechanism will include a pneumatic visor seal that incorporates safety backup sealing features.

Excessive wear of the suit torso has resulted from astronaut preflight training and checkout. It is proposed to provide new suit torsos to replace those that are extremely worn. The advanced state-of-the-art suit torso being designed for the manned 1-day-mission may fulfill this requirement.

Attitude control system.- The status of the attitude control system of both spacecraft configurations is as follows:

MERCURY 3-orbit missions.- The attitude control system of the spacecraft functioned satisfactorily during the MA-6 mission. However, since the MA-7 mission will require more manual control than the previous mission, the following changes have been incorporated.

(a) A maneuver off-on switch has been added to provide the astronaut with a control for automatic precession of the pitch gyro and slaving of the yaw gyro.

(b) The scanning slaver programmer has been bypassed to provide continuous scanner slaving with the gyro switch in the normal position. The gyro switch in the free position will eliminate scanner slaving.

(c) A provision has been added to provide proper attitude reference, after uncaging the gyros, without having to orient the spacecraft to a 0°, 0°, 0° attitude or to wait for scanner slaving correction. This change provides a better operational method of erecting the attitude reference system and will lower fuel consumption.

Manned 1-day-mission.- The control system of the manned 1-day-mission spacecraft will have the same changes as described in the preceding paragraph and will contain the following additional changes:

(a) The orbit mode attitude dead band will be increased from ± 3 degrees to ± 5.5 degrees in order to conserve fuel. This change will also be included in the MA-8 and MA-9 mission spacecraft.

(b) The fifth orbit mode pulse of the low thrusters will be changed from 0.7 second to continuous firing. This change will conserve fuel by keeping the control system from reverting to the orientation mode which would bring the large thrusters into operation.

Reaction control system.- Attitude control of spacecraft 13 was maintained throughout the MA-6 mission through use of the automatic and manual subsystems.

A malfunction of the automatic 1-pound yaw thrusters occurred at approximately the beginning of the second orbit of the mission making it necessary for the astronaut to switch to a manual mode for attitude control about the yaw axis during the remainder of the mission.

A postlaunch inspection of the thrusters revealed foreign material upstream of the fuel metering orifices. This foreign material has been identified as particles from the fuel distribution (Dutch Weave) screens located downstream.

Tests are continuing to resolve these thruster problems and to establish new thrust-chamber thermal configurations for the remaining spacecraft.

Pilot support and restraint.- Calculations of stress in the various leg bones indicates that the leg supports are not necessary for a normal mission. At the present time, a study is being made to determine the possible ill effects that would be sustained by the astronaut's legs as a result of the heat shield remaining in the "up" position during a water or ground landing. Until this study has been completed, unqualified approval for the removal of the leg supports cannot be justified.

Crew space layout, controls, and displays.- In general, the MA-6 spacecraft instrument-panel arrangement and interior configuration was excellent as exemplified by Astronaut Glenn's in-flight performance and his comments during his postflight debriefing sessions. The panel and crew space layout was the result of numerous modifications and improvements discovered during training and flight operations.

As a result of the MA-6 orbital flight, several additions and deletions of equipment concerning pilot control and display information were made in the MA-7 spacecraft. Some of the modifications are peculiar only to the MA-7 flight objectives, such as the balloon experiment. Other modifications are more basic for all future MERCURY flights, such as the "Maneuver Switch". The modifications are discussed below:

(a) Sequence panel override guards - these overrides, "RETRO SEQ.", ".05g", "DROGUE", which are actuated by a "push button" are now guarded.

(b) Fuse switch, sequence override and instrument color coating - provides the pilot with a quicker and more accurate means of locating the particular override or fuse switch and the reading of various meters and instrument displays, since each colored symbol is placed directly next to its respective fuse or switch.

(c) Onboard equipment bag - provides stowage for onboard research and personal equipment such as the camera, film packs, maps, charts, food, a knife, variable density extinction filter, eye piece, pliers, and so forth. This kit is similar to but smaller than the one used by Astronaut Glenn during the MA-6 flight.

(d) Maneuver switch - permits the astronaut to control automatic precession of the pitch gyro and slaving of the yaw gyro.

(e) Card clip - holds various checklists and other written information. This card clip is located on the door of the glove compartment which replaces the EPI.

(f) VOX transmit and record switch - provides a means for the astronaut to transmit and record, or to record only on the on-board recorder.

(g) Balloon switch (guarded) - deploys and releases the balloon during orbit. For more complete details on this switch, see the MA-7 flight plan for details of the balloon experiment.

(h) Isolated bus monitor - enables the pilot to check the rotary selector control switch in the "Bus Selector Control Position". This position was not used on previous missions.

(i) Semiautomatic blood pressure measuring system - becomes automatic after the pilot depresses the button, and remains on for 110 seconds unless the stop button is depressed.

(j) Suit and cabin steam and vent indicator and comfort controls - were added to provide the astronaut with a monitoring capability of the suit and cabin exhaust port temperatures. This capability will aid in the proper adjustment of the newly designed comfort controls, which have four settings: 1, 3, 5, and 7.

(k) Main inverters bus monitor - provides monitoring capability of the 250-volt, a.c. and 150-volt, a.c. main inverter bus bars plus the ASCS and Fans inverter bus outputs by means of a rotary selector control just below the A.C. voltmeter.

(l) Inverter temperature control handle - (located next to the comfort control handles) permits adjustment of the H_2O flow to the cold plates on the three inverters.

In addition to the modifications listed above, the following indicators and switches have been removed: the EPI, the coolant quantity indicator, the cabin relative-humidity indicator, the O_2 flow selector switch, and the O_2 quantity light and warning-tone signal.

Communications (onboard).- The status of the onboard communications equipment is as follows:

3-orbit missions.-

MA-6.- All spacecraft communication systems functioned satisfactorily during the mission. However, the following anomaly was experienced during the mission: spurious signals received by the Command Receiver triggered the "All function events channel" five times during the ionization blackout period, even though no events were initiated onboard the spacecraft.

Postlaunch investigations revealed that the combination of onboard transmitting frequencies were capable of producing a signal in the command receiver bandwidth. This problem has been eliminated by increasing the low-frequency telemetry transmitter frequency by one-half megacycle.

Voice-operated relay.- A private onboard recording channel will be provided so that the astronaut can record unusual phenomena or other observations not suitable for unrestricted broadcasting. This modification will be accomplished by adding a third position to the voice-operated relay switch. An unassigned track of the onboard tape recorder will be used to record these data.

Bicone antenna.- The reflecting fingers will be removed from the antenna canister of the spacecraft used in missions after MA-8. These reflecting fingers were used to increase the signal strength to ground stations, since the spacecraft orbit attitude was known. In future missions, the astronaut will allow the spacecraft to drift or he will perform planned maneuvers. Therefore, the removal of the reflecting fingers will allow better ground coverage during these periods of drifting or maneuvering.

Manned 1-day-missions.- The standards established for the communication systems on the manned 1-day-mission spacecraft require the deletion of the following equipment: one command receiver-decoder and the auxiliary decoder, one UHF voice transceiver, and the recovery HF voice transceiver. The standards also require the addition of ground command capability for the C-band and S-band beacons.

Instrumentation and recording system.- The status of the instrumentation and recording system is as follows:

3-orbit missions.-

MA-6.- The instrumentation and recording system onboard spacecraft 13 performed satisfactorily during the MA-6 mission. Telemetry coverage was excellent with ranges slightly exceeding horizon-to-horizon distances. Telemetry blackout occurred during reentry ionization as expected.

Telemetry transmitters.- Because of spurious command signals received during the MA-6 reentry, the low-frequency telemetry transmitter frequency for MA-7 and future flights will be increased one-half megacycle.

Low-level commutator.- A new low-level commutator will be added to the MA-7 and all subsequent spacecraft. The 30 channel-112.5 samples per second low-level commutator will be used to monitor special instrumentation onboard the spacecraft. The special instrumentation presently consists of 25 thermocouples which will be used to monitor thruster and external spacecraft temperatures during exit, orbit, and reentry. The data from the temperature survey will be recorded on the onboard tape recorder only.

Blood pressure measuring system.- Beginning with the MA-7 mission, a semiautomatic blood-pressure measuring system will be included as a part of the biomedical instrumentation. The advantages of the semiautomatic system versus the automatic system are that it is not as complicated, it is lighter, and it can be controlled by the pilot. Cuff inflations initiated by the automatic system during control maneuvers by the pilot are undesirable.

Retrofire timer.- A four-position clock with an output similar to the satellite clock is being developed for use in 3-orbit and manned 1-day-mission spacecraft. The clock will start at No. 2 retrofire time and will transmit "time since retrofire" signals to ground stations, thus enabling a better determination of the landing area, should retrofire occur while the spacecraft is out of range of a network station.

Respiration rate and depth sensor.- Work is proceeding on the flight version of a new Impedance Pneumograph (respiration rate and depth sensor) developed by Dr. L. A. Geddes of the Baylor University School of Medicine. This new sensor measures the chest cavity impedance using high-frequency current (50kc) in the two probes similar to electrocardiogram probes. The disadvantages of the present sensor are that incorrect readings result from head movement and suit circuit airflow. This new device has undergone breadboard tests at the McDonnell Aircraft Corporation and early test results are favorable.

Manned 1-day-missions.- Consistent with the standards established for the manned 1-day-mission configuration, several major changes will be made to the onboard instrumentation and recording system.

These modifications are as follows:

(a) The high-frequency telemetry transmitter system (including VCO's, commutator, and mixer) has been removed.

(b) A new solid-state telemetry transmitter is being proposed for the spacecraft instrumentation system. If this transmitter becomes available and fully qualified, it will be considered for incorporation into the system.

(c) It is anticipated that the new low-level commutator will also be included in the manned 1-day-mission spacecraft, and will be used for a temperature survey or for other special instrumentation. A new high-low level commutator with a total of 90 points is being considered as a possible replacement for the present commutators.

(d) A new CO_2 sensor and amplifier is being built for use in the suit circuit of the 1-day-mission spacecraft.

Power Supplies.-

3-orbit missions.-

D-C power supply.- No changes have been made since Status Report No. 13.

A-C power supply.- No changes have been made since Status Report No. 13.

Manned 1-day-missions.-

D-C power supply.- The D-C power for the manned 1-day-mission spacecraft is supplied by six silver-zinc batteries, five with 3,000-watt-hour ratings and one with a 1,500-watt-hour rating.

A-C power supply.- No change from 3-orbit configuration.

Launch Vehicle

Atlas performance.- The Atlas performance in the MA-6 mission was adequate and about as predicted. For the MA-7 flight, the booster-engine cutoff (BECO) time is being reduced by approximately 2 seconds in order to improve performance for this mission.

Atlas modifications.- Two major modifications will be made on future Atlas launch vehicles used for MERCURY missions. These modifications will be the removal of an insulation bulkhead and the substitution of baffle-injector booster engines for the flat-plate injector engines.

The removal of the nonsupport bearing insulation bulkhead is the result of a crack which was found in this bulkhead on the MA-6 mission launch vehicle and which required emergency corrective action before the launch could be effected. After careful study, it was determined that the presence or absence of this bulkhead did not affect the launch vehicles operation on MERCURY missions; therefore, this modification will be made on serial No. 113D (MA-8) and all subsequent MERCURY launch vehicles.

The use of baffle-injector booster engines on launch vehicles for MA-10 (1-day-mission) and subsequent missions will result in better fuel-flow conditions which virtually eliminates the rough combustion condition. The elimination of rough combustion will obviate the need of additional "pad holddown" and will result in better overall mission performance.

Atlas abort sensing.- Current status of the Atlas Abort Sensing and Implementation System (ASIS) is as follows:

(a) The booster-stage, lox-tank-ullage pressure-switch actuation level was set at 19.5 ± 1 psig for the MA-6 and subsequent missions.

(b) All other parameters remain as previously reported.

(c) The MA-6 mission was the fifth closed-loop mission for the system.

Crew Training

Major emphasis during this reporting period has been placed on the preflight preparation of the MA-7 flight astronauts (Carpenter and Schirra) of the upcoming orbital flight. The preflight training program, which is similar to that accomplished by the MA-6 flight astronauts, is well underway by the MA-7 flight crew. Although the preflight training accomplished by the MA-6 flight crew was quite thorough, the experience gained from the MA-6 flight did indicate that more emphasis was required in a few minor areas during the MA-7 preflight training. The training currently being accomplished by the MA-7 flight crew is discussed in the following paragraphs.

Spacecraft and booster familiarization.- The MA-7 flight astronauts have served as pilots and/or observers for the spacecraft and booster systems tests in the hangar as well as on the pad. In addition, the astronauts have attended several briefings and reviews with the spacecraft engineers. These activities have advanced their knowledge of the equipment both operationally and engineering-wise.

Trainers - Three trainers have been used by the MA-7 flight crew in preparation for the forthcoming flight. These trainers are: one, Langley Procedures Trainer; two, Alfa Trainer; and three, Cape Procedures Trainer.

In using the Langley Procedures Trainer, the MA-7 flight crew has concentrated its efforts on perfecting their technique in manually damping the reentry oscillations by using various reentry stability coefficients and manual control modes. The flight crew has also perfected the fly-by-wire yaw turnaround maneuver which occurs right after the spacecraft separates from the launch vehicle; and, in addition, they have practiced controlling vehicle rates and attitudes during numerous simulated retrofire maneuvers.

During the operations on the Alfa Trainer, the MA-7 pilots continued their attitude-control training by making various attitude maneuvers. The pilots also practiced controlling the spacecraft during retrofire disturbances while using various display references under both day and night lighting conditions.

Flight crew training in which the Cape Procedures Trainer was used, has been concentrated in the area of failure missions, full-mission simulation, and launch and network simulation. On failure-type missions, the astronauts have received considerable training in using a number of the various possible mission irregularities which usually necessitate an abort or early reentry. The flight crew also accomplished several full-mission simulations during which the normal inflight activities and overall mission requirements were practiced. In addition to the above operations, the flight crew was involved in launch abort and network simulations tying in the remote sites and other support personnel. Normal and emergency procedures as well as mission rules were rehearsed at this time.

Other training activities.- During this reporting period, other training activities which were accomplished by the MA-7 flight crew and the remaining astronauts are discussed in the following paragraphs.

(a) Transparent mockup for gyros simulation.- The MA-7 flight crew has devoted several hours to familiarization of the effects of pitch precession and gyro cross coupling on the gyro indications.

(b) Celestial navigation and observation.- The MA-7 flight crew also reviewed the celestial sphere at the Morehead Planetarium, Chapel Hill, North Carolina.

(c) Survival pack training.- On April 19, 1962, the MA-7 crew underwent a small-scale water exercise during which they were refamiliarized with the contents and use of their respective survival packs, including the boarding of liferafts.

(d) Egress training.- On March 4 and 5, 1962, the MA-7 crew underwent a full-scale water-egress exercise during which they made several side-hatch egresses in conjunction with helicopter pickups.

(e) Individual study.- The MA-7 crew has also spent considerable time in becoming knowledgeable of all phases of the upcoming flight through individual study.

All of the remaining astronauts have participated in the MA-7 preflight operations in one capacity or another. They have been working with engineering and operational groups, aiding and advising the flight astronauts themselves, acting as "Capsule Communicators" during simulations, and so forth. Several of the astronauts will again act as "Capsule Communicators" during the MA-7 flight. The astronauts have also been participating in several of the simulations being conducted by various contractors for the development and design of trainers, vehicle hardware, and crew-task requirements for the Gemini and Apollo programs.

Animal program.- A comprehensive animal program report which will be a NASA technical Report is now in the hands of the editor. It is entitled,"Results of the Project Mercury Ballistic and Orbital Chimpanzee Flights", and describes both the MR-2 and MA-5 mission in one volume. It has been prepared by members of the Manned Spacecraft Center, the Aerospace Medical Research Laboratory, the University of Southern California, and the McDonnell Aircraft Corporation. The report is being edited by the coordinator of the animal program in collaboration with the Aerospace Medical Research Laboratory.

A simulated rerun of the MA-5 chimpanzee mission at the University of Southern California is in progress. It involves a determination of all biomedical recordings including blood pressure and the behavioral performance based on procedures established for previous simulated Atlas orbital flights. Three other flight-trained animals are being submitted to the same studies, to determine the circumstances attending the blood-pressure increase of the MA-5 mission animal before and during the flight.

Two animal trailers, a caging and a training van, are on loan to Ames Research Center until that center can procure its own. Three additional vans are located at the University of Southern California to support the centrifuge runs.

QUALIFICATION PROGRAM

The qualification program for PROJECT MERCURY is so planned that as many hardware items as possible will be exposed to and their operation proven in those environments to which they will be subjected in both normal and emergency conditions for orbital flights. The following sections contain a discussion of the ground-test portion of this qualification program. The flight-test program is discussed in a separate section of this report.

McDonnell Qualification Program

The testing status of most of the primary subsystems for the manned 3-orbit mission and for the manned 1-day-mission is included in the discussion of each subsystem in the section entitled "Major Systems". The reliability and qualification tests for the 3-orbit mission are essentially complete. The tests for the 1-day-mission are currently being formalized by the McDonnell Aircraft Corporation.

The McDonnell Aircraft Corporation Report 8140 "Contractor Furnished Equipment Status Report", showing status of the qualification tests as of March 1, 1962, has been submitted.

Systems Tests

The current test status of the various MERCURY systems is as follows:

Reaction control system.- During the reporting period of February 1 to April 30, 1962, emphasis has been placed on an investigation to define and remedy the problem areas that have been experienced in the orbital mission conducted to date. Considerable study and investigation have also been conducted to define the RCS configuration for the manned 1-day-mission spacecraft.

(a) Problem areas.- The particular problem under investigation is the 1-pound thruster, which has malfunctioned during each orbital mission. Only the malfunction which occurred during the MA-5 mission (spacecraft 9) has been satisfactorily explained. This malfunction was the result of a clogged orifice caused by a metallic chip. Some particles from the eroded stainless steel Dutch Weave screen were found in the orifices of discrepant thrust chambers on the MA-6 mission spacecraft.

In an effort to provide more dependable thruster assemblies, an interim design for the thruster has been developed. This design incorporates platinum screens, instead of the stainless steel screens, in both the 1-pound and 6-pound thruster assembly and also incorporates a stainless steel distribution plate in the 1-pound thruster assembly. The orifice was moved from the downstream side of the solenoid valve to the solenoid valve inlet.

This thruster configuration has been proven in Project Orbit tests and is now installed on the MA-7 spacecraft.

Landing system.- Tests are being conducted to reproduce the early drogue deployment experienced on the MA-6 mission. Attempts are now being made to reproduce an environment which will produce a pressure disturbance in the barostats that will cause premature actuation.

Other tests.- A retropack cooling test has been conducted during the loxing of the MA-7 launch vehicle booster. The purpose of the test was to determine temperatures within the adapter area after the longest anticipated hold period prior to launch of an Atlas booster vehicle. Temperatures were measured on the skin of the retropack and inside an inert retrorocket motor. One free-air temperature pickup was mounted 6 inches below the heat shield and equidistant between the retropack and the inner skin of the adapter. Temperatures were recorded for approximately four hours and final results will be published by Cape personnel in the near future.

Manned 1-day-mission.- Integrated systems tests will be performed on the manned 1-day-mission spacecraft with spacecraft 9A being used as the test vehicle. Spacecraft 2 will be used to conduct RCS tests, and spacecraft 10 will be used for special tests. These tests will be conducted as part of Project Orbit.

LAUNCH OPERATIONS

Spacecraft preparation.- Spacecraft 13 (MA-6) was successfully launched on February 20th after previous launch attempts (January 27 and during the week of February 13) were canceled because of weather conditions. Upon return of the spacecraft to the Atlantic Missile Range (AMR), extensive postflight inspection and tests were performed prior to its return to St. Louis.

Spacecraft 18 (MA-7) and 16 (MA-8) have been undergoing prelaunch work and testing during the period covered by this report and spacecraft 18 is scheduled to move to the launch pad on April 28, 1962.

Spacecraft 19 (MA-9) was received at AMR on March 20th and has been in work through the end of this reporting period in preparation for a 3-orbit mission.

MA-8 and MA-9 mission spacecraft have been placed on a two-shift, 5-day workweek in place of the three-shift, 6-day and 7-day workweek used in preparations for previous flights.

Coordination.- Range support documentation was completed for the MA-6 operation and has been submitted for the MA-7 mission.

Coordination between the Department of Defense (DOD) and NASA agencies for the MA-6 mission was successfully completed. Coordination for the MA-7 mission is currently being performed.

The manned and operational procedures for the prelaunch and launch periods were exercised during the MA-6 checkout operations. Emphasis is again being placed on emergency egress rehearsal and the finalizing of supporting egress procedures prior to the MA-7 launch.

Data coordination procedures were satisfactory during this reporting period and were effective for the MA-6 operation. The Data Acquisition Plan for the MA-7 mission is completed.

Management and operation of the MERCURY Network was successful for the MA-6 mission which included simulation and training exercises in preparation for the MA-6 mission. Simulation and training exercises in preparation for the MA-7 mission are currently being performed.

The manned orbital procedures for prelaunch, launch, and mission periods have been exercised during this reporting period and are described in greater detail in the Flight Operations section of this report.

Cape and Patrick facilities.- The existing Cape facilities for MERCURY support have been altered during this report period by the addition of an Analytical Chemistry Laboratory for the testing of MERCURY spacecraft associated gases. The hangar S library has been moved from a temporary trailer to the hangar. The laboratory and library are presently being established on the north side of the hangar floor in the space vacated by the Instrumentation Laboratory, which has been moved to the new South Annex. The Communications Laboratory has been moved to larger quarters in an adjacent space.

Flight Control Operations and Training

During the first 7 days of February 1962, the Flight Controllers from the United States and Bermuda were returning to MSC since the MA-6 launch date had been rescheduled for February 13, 1962. By February 11, 1962, all MERCURY sites were manned for the continuation of the mission. Following the actual launch on February 20, 1962, the postlaunch reports were written at the Cape. By February 24, 1962, the MERCURY Control Center (MCC) Flight Controllers had returned to MSC and other personnel were enroute. The MA-6 debriefing was held at MSC on March 3, 1962.

Continuing experience indicates that changes are required in the following operational procedures: flight controller teletype procedures, voice-reporting procedures, astronaut-flight controller voice procedures, and consequent changes in message formats.

Nine of the Bermuda event-telemetry signals will be relayed to MCC. Also, an improved and shortened Network/Remote Site Count has been completed for the MA-7 mission. There is now a general trend toward more manual control of the spacecraft in the MA-7 Flight Plan. Improved data flow and display procedures will be implemented at MCC to improve the quality and speed of data being transmitted to and from the flight controllers. Many of the flight-control supporting documents have been changed to reflect the above operational changes.

In order to support future missions, the Flight Operations Division, Flight Control Branch, has initiated an extensive training program for new flight controllers. At the present time, eight men are actively engaged in this full-time program. These men, and others to come, are expected to be operational for the MA-8 mission.

Advanced MERCURY plans.- The preliminary draft of the "One-Day Mission Operations Plan" is presently in reproduction; and, in the near future, will be circulated through the division for review. The "Extended Mercury Mission Feasibility Study" is now being reviewed by the division.

Recovery Planning and Preparation

Advanced recovery requirements.- A briefing on recovery requirements for MERCURY flights MA-7 through MA-13 was presented to the Chief of Naval Operations on March 22, 1962. This information has been incorporated into a document entitled "NASA Project Mercury Advanced Recovery Requirements", which is being reviewed for publication. This document, which may be used for preliminary planning, will be forwarded to the DOD Representative of PROJECT MERCURY for distribution to the agencies concerned with the support of MERCURY recovery operations. A similar document will be prepared to present contingency recovery requirements for the next 10 years.

Swimmer training.- The swimmers scheduled for the primary landing areas for the MA-7 mission were trained at the U.S. Naval Air Station, Pensacola, Florida, starting on April 30, 1962. Training included films, briefings, several actual auxiliary collar deployments, and jumps from a helicopter. The swimmers were also given detailed instructions and practice in the care and use of the collar.

Astronaut egress and recovery exercises.- Plans were completed for training exercises at Cape Canaveral for the primary and backup astronauts of the MA-7 mission. Training will include top- and side-hatch egresses, egress with the flotation collar attached and subsequent pickup by HUS or HR2S helicopters, survival and flotation equipment training, and complete recovery sequence training with swimmers, flotation collars, and helicopters.

Recovery equipment.- Studies of the equipment required for recovery forces to be used in the Pacific area for 1-day-missions were completed. Action was initiated to procure additional boilerplate training spacecraft, search aircraft, special receiver equipment, spacecraft emergency flotation bags, antenna cutters, nylon recovery whips, recovery hooks, and davit standoff rigs to meet the requirements.

Repair and overhaul activities were intensified to improve the availability of special search receivers and RADARC drop buoys.

1-day-mission parachute qualification tests.- Special cargo hooks to equip two Marine HR2S helicopters for support of the low altitude phase of the tests were delivered to MAG-36, MCAF Santa Ana, California. MSC personnel assisted in the installation and checkout of the hooks and briefed the flight crews on past experience in similar programs.

MA-6 recovery operations.- All recovery forces assigned for MA-6 were on station at the planned launch time. These forces in the Atlantic recovery areas consisted of 3 salvage ships; 17 destroyers (DD's); 1 oiler (AO); 3 aircraft carriers (CV's), each with 3 helicopters embarked; 7 P2V aircraft; 3 5PM aircraft; 3 WV aircraft; and 2 AFMTC C-130 telemetry aircraft. The CV's together with 2 DD's and supporting aircraft were positioned in the planned landing areas at the end of the first, second, and third orbit. The remaining Atlantic recovery forces were located along the first-orbit ground track from Cape Canaveral to the coast of Africa. In addition, helicopters, amphibious surface vehicles, and small boats were positioned for recovery support near the launch pad. A large number of Air Rescue Service aircraft were on alert at various staging bases throughout the world.

Weather conditions were favorable for location and retrieval in all Atlantic recovery areas and were good in contingency areas. Recovery communications were good throughout the entire operation; and forces were informed of mission status during the launch, orbital, and reentry phases. Due to mission progress, units in the planned third orbit landing area were alerted for a landing, and based on tracking data, were informed at 04:46:00 to orient their search effort about latitude 21°29' North and longitude 68°48' West. In the meantime, lookouts on the destroyer Noa stationed at the uprange end of the planned landing area sighted the main parachute and spacecraft. The Noa established communication with the Astronaut and at 05:07:00 was alongside the spacecraft. The Astronaut remained in the spacecraft during retrieval and egressed through the side hatch after the spacecraft was secured on the recovery ship. The Astronaut was clear of the spacecraft at 05:34:00.

All spacecraft recovery aids apparently functioned normally. Search aircraft in the landing area reported contact with both SARAH recovery beacons and with the UHF transceiver. The dye marker and flashing light were reported to be functioning. A SOFAR fix, approximately 4 miles from the spacecraft retrieval position, was available at the recovery center about 1 hour after landing. The SEASAVE fix was about 25 miles from the retrieval position.

Contingency recovery planning.- Preliminary studies of the contingency recovery support requirements for the manned 1-day-mission have been made in conjunction with the "Advanced Recovery Requirements". Operational support elements, tentative staging locations, specialized equipment requirements, communications channels, and diplomatic clearance requirements were considered. DOD organizations currently supporting MERCURY contingency recovery have been briefed so that preliminary support planning can begin.

Flight Safety

Factory rollout inspection of launch-vehicle.- The U.S. Air Force/Aerospace factory rollout inspection of the Atlas launch-vehicle 107D, to be used on the MA-7 mission, was held at General Dynamics/Astronautics, San Diego, California, during the week of February 25, 1962. The launch vehicle was accepted on March 2, 1962, and was shipped to the Atlantic Missile Range (AMR) on March 8, 1962.

Preflight flight safety reviews at AMR. -MA-6.- As reported in the last status report (No. 13) the insulation and insulation bulkhead were removed from vehicle 109-D. This work caused the launch to be rescheduled for February 13, 1962. A special flight-safety-review meeting was held on February 9, 1962, at SSD Headquarters, Los Angeles, California, to discuss the results of studies made on the insulation bulkhead effects. The second mission review meeting on MA-6 was held on February 12, 1962, and all systems were found ready for flight. The booster status review meeting and review-board meeting were held on February 13, 1962. Weather forced three more postponements of launch to February 14, 15, and 20, 1962. No spacecraft meetings were held during this period. The final booster-status-review meeting and flight-safety board meeting were held on February 19, 1962, and the MA-6 mission was accomplished on February 20, 1962.

MA-7.- The launch vehicle (107-D) was erected on March 14, 1962. The interface committee had an inspection meeting on April 27, 1962, prior to the spacecraft 18 mating on April 28, 1962.

Reliability.- The MERCURY manned 1-day-mission configuration as of March 1962 is being analyzed to provide an estimate of mission success and flight safety. The analysis is scheduled for completion in July 1962.

The McDonnell Aircraft Corporation is classifying failure reports to identify those which might cause a "hold" or an "abort" in order to concentrate effort in finding the correction action for such failures.

McDonnell Aircraft Corporation's reliability program plan has been disapproved, since it is insufficient in detail to evaluate. A joint meeting of McDonnell Aircraft Corporation and MSC has been proposed to resolve the insufficiency of the program.

FLIGHT TEST PROGRAM

Atlas Flights

MA-6 mission.- This mission consisted of 3-orbits with Astronaut John H. Glenn, Jr., as pilot. Unscheduled prelaunch holds totaled 2 hours and 17 minutes. This delay was a result of difficulties encountered with the General Electric guidance rate beacon, a broken spacecraft hatch bolt, topping and loxing the fuel tanks and liquid oxygen tanks, respectively, and verification of the network computer in Bermuda, which had encountered a ground power failure. The vehicle lifted off at approximately 0947 e.s.t. on February 20, 1962, 3 hours and 42 minutes after the Astronaut entered the spacecraft.

All launch-vehicle functions were normal during launch, and vibration levels and frequencies were acceptable and comparable to those experienced during the MA-5 mission. Spacecraft orbital insertion conditions were very good. Deviations from nominal values of inertial flight-path angle and velocity were -.05 degree and -7 feet/second, respectively, with a resultant capability of nearly 100 orbits. General Electric-Burroughs and AZUSA guidance data both indicated a "GO" condition after sustainer engine cutoff. The perigee and apogee of the orbit differed from the nominal values of 87.0 and 144.4 nautical miles by 0.1 nautical mile and 3.5 nautical miles, respectively.

Spacecraft separation, rate damping, and turnaround were accomplished satisfactorily. With the exception of steadily rising temperatures on both inverters, all spacecraft systems performed satisfactorily during the first orbit.

The pilot observed the launch vehicle tankage in its slightly lower orbit for some time, checked out the spacecraft control systems, performed planned tasks and made scientific observations, and reported small luminous-appearing particles around the spacecraft at sunrise.

At approximately the beginning of the second orbit, the Astronaut reported that the spacecraft was not maintaining acceptable attitudes in the orbit mode of control in right yaw, and later in left yaw, evidently because of loss of thrust from the low thrusters. The Astronaut elected to control the spacecraft manually to conserve fuel, and flew most of the rest of the mission in manual control modes. Necessary attention to control of the spacecraft prevented the accomplishment of some flight-plan items, although all major planned tasks were accomplished. The Astronaut also made scientific observations, confirmed that major weather phenomena were visible on the moonlit dark side of the earth, controlled the spacecraft attitudes by visual reference to horizon and stars on the dark side of the earth, and performed spacecraft maneuvers manually, including 180 degree yaw maneuvers. The spacecraft supported the Astronaut adequately, despite the malfunction in the control system.

During the second and third orbits, an indication from telemetry that the spacecraft heat shield might be unlocked caused some concern; therefore, the empty retropack was retained on the spacecraft during reentry at the end of the third orbit to hold the heat shield in place in case it was unlatched. The retropack had no detectable effect on the reentry.

Network operations, including telemetry reception, radar tracking, communications, command control and computing were excellent, and permitted effective flight control during the mission.

MA-7 mission.- The 3-orbit MA-7 mission is scheduled for the week of May 21, 1962, with Astronaut Carpenter or Schirra as the pilot. Spacecraft 18 will be used. In addition to control exercises and scientific observations, the flight plan includes observations of the behavior of a liquid in zero-gravity environment, and the behavior of an inflatable sphere to be ejected from the spacecraft in orbit.

PUBLICATIONS

The following papers relative to PROJECT MERCURY have been published during the past 3 months:

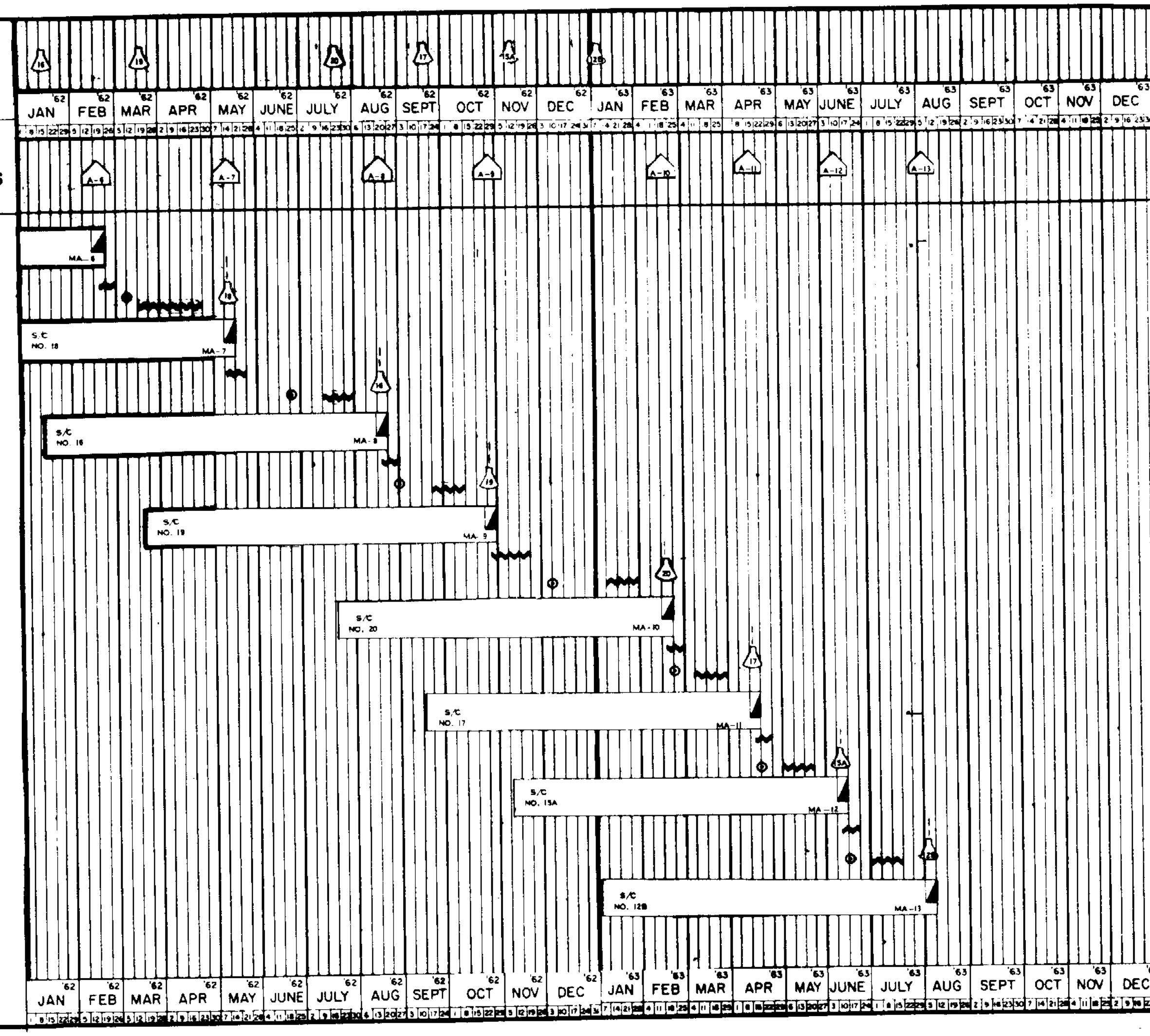
1. Anon.: Mercury Atlas Technical Review for 93-D (MA-5). N-107,134.

2. Anon.: Results of the First U.S. Manned Orbital Space Flight, February 20, 1962.

3. Anon.: Orbital Flight of John H. Glenn, Jr. N62-10740.

SPACECRAFT DELIVERIES

LAUNCH PERIODS



S/C NO.	USE	MISSION	DATE LAUNCHED
1	BEACH ABORT	SYSTEM QUAL. TEST ESCAPE-LAND G.-POSTLAND G. UNMANNED	5-9-60
2	MR-1	BALLISTIC-UNMANNED	12-19-60
3	LJ-5	MERC. MAX Q ABORT UNMANNED	11-8-60
4	MA 1	MAX G MAX HEAT ON AFTERBODY - UNMANNED	7-29-60
5	MR-2	BALLISTIC-PRIMATE	1-31-61
6	MA-2	MAX G MAX HEAT ON AFTERBODY - UNMANNED	2-21-61
7	MR-3	BALLISTIC - MANNED	5-5-61
8	MA-3	ORBITAL - UNMANNED	4-25-61
8 A	MA 4	ORBITAL - UNMANNED	9-13-61
9	MA-5	ORBITAL - PRIMATE	11-29-61
10	GROUND TEST	ORBITAL FLIGHT ENVIRONMENTAL TEST	
11	MR-4	BALLISTIC-MANNED	7-21-61
12 B	MA-13	ORBITAL MANNED ONE DAY MISSION	
13	MA-6	ORBITAL-MANNED	2-20-62
14	LJ-5A	MERCURY MAX Q ABORT UNMANNED	3-18-61
14A	LJ-5B	MERCURY MAX Q ABORT UNMANNED	4-28-61
15 A	MA-12	ORBITAL - MANNED ONE DAY MISSION	
16	MA-8	ORBITAL - MANNED	
17	MA-11	ORBITAL - MANNED ONE DAY MISSION	
18	MA-7	ORBITAL - MANNED	
19	MA-9	ORBITAL - MANNED	
20	MA-10	ORBITAL - MANNED ONE DAY MISSION	

KEY

SPACECRAFT PERIOD AT CAPE

LAUNCH WEEK
PLAIN - UNMANNED
HATCHED - PRIMATE
SOLID - MANNED

⊙ EST BOOSTER DELIVERIES AT CAPE

PAD CONVERSION AND BOOSTER CHECKOUT AFTER ERECTION

ABBREVIATIONS
S/C - SPACECRAFT
MA - MERCURY ATLAS
MR - MERCURY REDSTONE
LJ - LITTLE JOE

Figure 1.- PROJECT MERCURY Master planning schedule status as of 4-30-62